



**Europäisches
Patentamt**

**European
Patent Office**

**Office européen
des brevets**

Urkunde Certificate Certificat

Es wird hiermit bescheinigt, daß für die in der beigefügten Patentschrift beschriebene Erfindung ein europäisches Patent für die in der Patentschrift bezeichneten Vertragsstaaten erteilt worden ist.

It is hereby certified that a European patent has been granted in respect of the invention described in the annexed patent specification for the Contracting States designated in the specification.

Il est certifié qu'un brevet européen a été délivré pour l'invention décrite dans le fascicule de brevet ci-joint, pour les Etats contractants désignés dans le fascicule de brevet.

Europäisches Patent Nr.

European Patent No.

Brevet européen n°

0547667

Patentinhaber

Proprietor of the Patent

Titulaire du brevet

PIRELLI CAVI S.p.A.
Viale Sarca, 222
I-20126 Milano/IT

Best Available Copy

München, den
Munich,
Fait à Munich, le

13.12.95

Paul Braendli

Paul Braendli

Präsident des Europäischen Patentamts
President of the European Patent Office
Président de l'Office européen des brevets

This Page Blank (uspto)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number : **0 547 667 B1**

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification :
13.12.95 Bulletin 95/50

(51) Int. Cl.⁶ : **H02G 15/18, F16G 11/00**

(21) Application number : **92203797.3**

(22) Date of filing : **07.12.92**

(54) **Tubular supporting element for a sleeve for covering junctions, particularly of cables for transmitting electrical energy, and process and apparatus for the accomplishment of the above mentioned tubular supporting element**

(30) Priority : **16.12.91 IT MI913362**

(43) Date of publication of application :
23.06.93 Bulletin 93/25

(45) Publication of the grant of the patent :
13.12.95 Bulletin 95/50

(84) Designated Contracting States :
DE ES FR GB

(56) References cited :
EP-A- 0 117 092
EP-A- 0 291 203
EP-A- 0 399 263
GB-A- 1 292 608
US-A- 4 389 440
US-A- 4 503 105

(73) Proprietor : **PIRELLI CAVI S.p.A.**
Viale Sarca, 222
I-20126 Milano (IT)

(72) Inventor : **Portas, Francesco**
Via Roma, 4
I-15028 Quattordio (Alessandria) (IT)

(74) Representative : **Marchi, Massimo et al**
c/o Marchi & Mittler s.r.l.
Viale Lombardia 20
I-20131 Milano (IT)

EP 0 547 667 B1

Note : Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

The present invention relates to a tubular supporting element for a sleeve for covering junctions, particularly for cables for transmitting electrical energy, and process and apparatus for the accomplishment of the abovementioned tubular supporting element.

In order to execute the junction of cables for the transmission of electrical energy at medium and high voltages (higher than 10 KV), the extremities to be joined are deprived of the protection and insulation sheaths, so as to expose the electrical conductors and to make it possible to join them by means of welding or by means of clamping terminals; the junction area is then coated with suitable materials, such as putties, self-amalgamating tapes and such like, and over the extremities of the cables there is fitted a cover sleeve in elastomeric material, which has the functions of protecting and insulating the junction.

Covering sleeves are also applied to tubes, bars and such like, to obtain local protection against corrosion or for other purposes.

In order to fit a covering sleeve over a junction of electrical cables it has been proposed to arrange it over tubular elements of rigid plastic materials, capable of keeping it under conditions of elastic expansion.

The tubular element is fitted over the extremity of one cable before the junction is executed and, once the connection between the conductors has been made, it is removed by slipping it off the sleeve, which in this way can contract elastically and tighten itself over the cables at the junction.

Different forms of embodiments have been proposed to facilitate the operation of extracting the tubular supporting element.

In the English patent No. 1.292.608 there is described a hollow nucleus for supporting an elastic sleeve, formed by a pipe in plastic material having a deep helical groove on its external surface; there is thus defined a strip wound like a helix with the adjacent turns interconnected by a thin cord which forms a preferential line of breakage and allows the separation of the turns, pulling one extremity of the strip; in this way the pipe is removed in the form of a continuous thin strip, allowing the sleeve to contract over the cables.

The US patent No. 4.389.440 describes a hollow nucleus for supporting an elastic sleeve, formed by a tape in plastic material wound in a spiral, having thinned-out edges, constrained at certain points so as to form a substantially rigid pipe, that can collapse and be removed to allow the abovementioned sleeve to be fitted.

The US patent No. 4503.105 relates to a tubular nucleus formed by a plastic pipe whose wall is provided with internal ribs, axially directed and distanced in

a circumferential direction, and is externally cut along a helical line, so as to form a continuous helically-wound strip, held together by the axial ribs.

The European patent application No. 0.291.203 describes a helical support obtained from a tubular casing in whose walls passing notches arranged along the helical line have been cut, distanced in a circumferential direction and staggered, so as to leave in between the notches themselves connection areas of resistance such as to allow the helical support to be undone manually, by pulling on an extremity; the incisions are made by means of a tool constituted by a toothed cutting wheel.

When the helical support is obtained from a tubular casing with a helical incision, accomplished with tools operating by the removal of chips, the width of the incisions themselves is at least equal to the thickness of the tool.

With tubular supporting elements of the type described in the abovementioned patents, provided with external helical incisions, deformations of the internal wall of the sleeve made of elastomeric material are inevitable, and this can lead to serious drawbacks.

In fact the fitting of the sleeve over the tubular supporting element is executed during the manufacturing stage, and thus the sleeve and the tubular supporting element remain engaged for a long period of time before the tubular supporting element is removed to execute the fitting of the sleeve over a junction of electrical cables.

It thus occurs that the sleeve, mounted onto the tubular supporting element under conditions of high elastic expansion, exerts on this a strong centripetal compression, which, in the presence of discontinuities, such as incisions or notches, in the wall of the tubular element itself, leads the sleeve material to insinuate itself inside the incisions or inside the notches, with consequent deformations of its internal wall.

It so happens that these deformations are not completely eliminated in the short time span between the removal of the tubular supporting element and the contraction of the sleeve round the electrical cables of a junction. In fact the materials that are suitable for accomplishing elastic sleeves for junctions of electrical cables, after remaining in conditions of elastic deformation for a certain period of time, exhibit a certain value of residual deformation which, at room temperature, can only be recovered after a few hours or days.

Thus, between the internal wall of the sleeve, which remains deformed, and the external surface of the insulation of the cables, inclusions of air are formed, with highly detrimental consequences, since, when air ionises in the presence of the strong electrical fields existing in the junction during use, can produce partial discharges, of an intensity equal to several tens or hundreds of picoCoulombs, which jeopardise the functionality of the sleeve and of the junction.

tion as a whole.

In the Italian patent application No. MI 91 A 001416, filed on 23 May 1991 in the name of the same Applicant, there is described a tubular supporting element of a sleeve made of elastomeric material, having a smooth and continuous external wall and provided with a helical groove, with a substantially triangular or trapeze-shaped cross-section, obtained on its internal wall.

This solution, which allows the external surface of the tubular support to be smooth, reduces the resistant cross-section of the tubular casing itself, with respect to the condition of the integral pipe, limiting the pressure that it can sustain for a given wall thickness.

According to the present invention a tubular supporting element of a sleeve for covering junctions has been found, as defined in claim 1.

According to another embodiment the present invention relates to a process for making a tubular supporting element of a sleeve for covering junctions, as defined in claim 7.

According to a further embodiment, the present invention provides for an apparatus suitable for making a tubular supporting element of a sleeve for covering junctions, as defined in claim 11.

With this solution it is possible to obtain a tubular supporting element of a covering sleeve that has the wall in contact with the abovementioned sleeve that is in practice smooth, even with a helical incision made on the same contact wall, and a resistant cross-section of each turn that is substantially rectangular capable of supporting comparatively high loads of centripetal compression, substantially similar to that of the integral tubular casing.

Features and advantages of the invention shall now be illustrated with reference to preferred embodiments represented as non-limiting examples in the enclosed drawings, wherein:

Fig. 1 is a view in partial axial cross-section of a sleeve for covering a junction between electrical cables and of a tubular supporting element accomplished according to the invention;

Fig. 2 is a partial view in axial cross-section of a junction between electrical cables using the covering sleeve and the tubular supporting element of Fig. 1, represented on an enlarged scale;

Fig. 3 is a front view, in partial cross-section, of an apparatus for the accomplishment of the tubular supporting element of Fig. 1;

Fig. 4 is an enlarged lateral view of a supporting chuck, of a tubular supporting element and of tools of the apparatus of Fig. 3;

Fig. 5 is a partial perspective view of a supporting chuck, of a tubular supporting element and of tools of the apparatus of Fig. 3;

Fig. 6 is a side view, in partial cross-section, of the supporting chuck, of a tubular supporting ele-

ment and of a tool of Fig. 5;

Fig. 7 is an enlarged view in partial cross-section of the tubular supporting element of Figs. 5 and 6;

Fig. 8 is a variant of the supporting chuck of Figs. 5 and 6;

Fig. 9 is a diagrammatic view of another embodiment of the invention.

There is indicated in Fig. 1 with 1 a covering sleeve in elastomeric material having an internal wall 2; the sleeve 1 has functions of protection and insulation of a junction between two electrical cables, indicated as a whole with 3 in Fig. 2, for the transmission of electrical energy at medium or high voltages; there is indicated as a whole with 5 a tubular supporting element over which the sleeve 1 is fitted under conditions of elastic expansion of the order of 100% for junctions of high-voltage cables and of the order of 200%-300% for junctions of medium-voltage cables.

The tubular element 5 has an external wall 6 provided with a non-passing incision 7 directed along a helical line, which at its mouth 8 on the surface of the tubular element has a reduced width, less than 0.1 mm, and preferably less than 0.05 mm; as also shown in Fig. 7, such incision accomplishes a strip 9 with a substantially rectangular cross-section, wound like a helix with adjacent turns interconnected by an internal cordon 10 having a reduced thickness, that is also wound according to the abovementioned helical line, that constitutes a preferential line of breakage; there is indicated with 11 an extension of the strip 9, which extends outside the tubular element 5.

The tubular element 5 is made of plastic material such as PVC (polyvinylchloride), polyolefines, polyamides and such like.

Since the incision 7 has a mouth 8 with an extremely limited width, the external wall 6 of the tubular element 5 is in practice smooth and thus the wall 2 of the sleeve 1 undergoes no deformation even though it may remain engaged with the wall 6 for a long period of time before the same sleeve 1 is applied to a junction of electrical cables; the tubular element 5, being formed by the strip 9 with a substantially rectangular cross-section, has a resistant cross-section suitable for supporting the considerable centripetal compression exerted by the sleeve 1, that can be of the order of 1 MPa, that is, a resistant cross-section substantially equal to, or only slightly less than, the resistance of the integral tubular casing, that is, having no incision 7.

There is illustrated in Fig. 2 the assembly diagramme of the sleeve 1, with the help of the tubular element 5, on a junction, indicated as a whole with 15 between the electrical cables 3.

The cables 3 comprise respective conductors 16 covered with insulators 17, with capacitative shields 18 and with external protective sheaths 19; after the

set consisting of the tubular supporting element 5 and of the sleeve 1 has been fitted over the cable 3, in the junction area the extremities of the cables 3 are deprived, one after the other, of their respective protection and insulation coverings, so as to lay bare the respective conductors 16 and to connect them together through a terminal 20; round the junction 15 there is added a suitable filling material, not shown, such as putty in the paste state or self-amalgamating tapes and the junction 15 is then covered again with the sleeve 1.

When traction is exerted on the extension 11, the first turn of the strip 9 becomes separated from the tubular element 5 and turns are in this way progressively detached due to the effect of the tearing of the cordon 10 having reduced thickness, so that the tubular element 5 itself, while it is being undone, is removed and the sleeve progressively contracts over the cables 3 so as to restore conditions suitable for the proper operation of the cables.

The contraction of the sleeve 1 exerts an auxiliary force on the turn being pulled through the extension 11 and facilitates the collapse of the tubular element 5.

There is indicated in Fig. 3 with 22 a supporting chuck that is rotatable and axially displaceable, as indicated by the arrows 40 and 41 of Figs 4 and 6, over which the tubular element 5 is fitted under conditions of radial interference, against a shoulder 24, which conveniently has a tooth 24a suitable for transmitting the rotation to a tubular element 5 being processed; the chuck 22 is rotatably supported in a fixed supporting structure, indicated as a whole with 23 and in a slidable supporting structure, indicated as a whole with 25, mounted on guides 26 and operated, by means of a transmission comprising a screw having helical teeth and balls 27, a worm gear with balls 28 and a gear reduction unit 29, an electric motor 30; the chuck 22 is operated in rotation by an electric motor 31, through a transmission 82.

There is indicated with 33 a mechanical processing tool for the removal of chips, also visible in Figs 4, 5, 6, held in a supporting structure 34, provided with a cutting blade having a thickness ranging from 0.8 to 1 mm, suitable for making in the external wall 6 of the tubular element 5 the helical incision 7 by means of the removal of chips 35, as shown in Fig. 5.

There is indicated with 36 a shaving tool, also shown in Figs 4 and 5, held in a supporting structure 37, that is used to remove from the wall 6 the crests of material, indicated with 38 in Fig. 7, that are formed at the sides of the mouth 8 of the incision 7, during the processing of the tool 33.

In order to proceed with the incision of the tubular element 5 with the incision width indicated above, this is fitted over the chuck 22 under conditions of radial interference, such as to substantially prevent the longitudinal (or axial) expansion of the tubular ele-

ment 5 while the abovementioned incision 7 is made; the interference, for example, ranges from 0.2% to 0.5% of the internal diameter of the tubular element itself with materials having a coefficient of elasticity $E = 800$ to 1000 MPa, so that, due to the friction between the tubular element and the chuck that supports it, there is accomplished an axial containment of the tubular element itself.

The helical incision 7 is made by the tool 33, while the chuck 22 is operated by the motors 30 and 31 in rotation and translation, operating at room temperature, so that the material heated by friction flows outwards and goes to partly fill the incision 7 in the proximity of the mouth 8; the crests 38 that are formed are then removed by the shaver 36.

It has been noted that with the apparatus and the method described it is possible to obtain a tubular element 5 formed by a strip 9 having a substantially rectangular, or square, resistant cross-section that is especially strong, wherein the incision 7 has a width at the surface of the tubular element that is less than 0.1 mm, possibly even less than 0.05 mm, in relation to the magnitude of the containment accomplished.

After the removal, if any, of the crests 38, by means of the shaving tool 36, the external surface of the tubular element 5 is in practice smooth and causes no deformation of the internal wall 2 of the sleeve 1.

With the apparatus and process indicated above it is possible to accomplish tubular supports suitable for holding elastic sleeves of the type described using commercial extruded pipes, without requiring for them particular qualitative prescriptions, such as, for example, polypropylene pipes according to DIN 8077 specifications.

In fact, on the basis of such specifications, extruded pipes can have a wall thickness tolerance up to $0.1 s + 0.2$ mm, where s is the nominal thickness of the wall, due, for example, to the ovalisation of the pipe or to the eccentricity of the external and internal surfaces.

Under such conditions, operating according to the invention it is in any case possible to ensure a constancy of the thickness in the connecting area 10 between the turns, since the forced assembly of the tubular element 5 being processed on the chuck 22 forces its internal surface to match perfectly the surface of the chuck itself, which being made preferably of metal, can be manufactured with the necessary dimensional accuracy.

The tool 33 can then be arranged in an accurate position with respect to the chuck surface and thus the thickness of the area 10 is kept constant with a high degree of accuracy, without the possible eccentricity or ovalisation of the starting pipe having an appreciable influence.

On the basis of what has been described above, a tubular support for elastic sleeves has been accom-

plished starting from a commercial pipe made of polypropylene, having internal diameter of 45 mm and external diameter of 51 mm; the support had a useful length, after eliminating the initial and final processing extremities, of some 50 cm.

The starting pipe, about 60 cm long, has been forcibly introduced on a chuck 22 having a diameter of 45.2 mm.

The processing tool had a thickness of 0.8 mm and, during processing, it penetrated into the thickness of the wall of the pipe leaving a residual thickness of 0.5 mm.

Under these conditions a tubular support has been obtained wherein the width of the helical incision, at the external surface, has been measured to range from 0.05 mm to zero, meaning by this that in some areas the sides of the incision were locked together, making it impossible to introduce a feeler gauge into the incision itself.

With the same tool, but operating in the absence of force on the tubular element, which has been processed by keeping it supported on a chuck having a diameter of 45.0 mm, a width of incision has been obtained that is substantially equal to the thickness of the tool used.

It is believed that the result obtained is due to the fact that, in the presence of a forced assembly of the pipe on the chuck, a force is generated by friction between the chuck and the pipe that opposes a longitudinal extension of the pipe itself during processing, that is, the pipe is in a state of containment of its axial extension.

This means that, since an axial extension is inhibited, in order to leave space for the tool that penetrates into the thickness of the wall of the pipe to accomplish the incision, the material is elastically compressed round the tool, returning elastically to the previous dimension after the passage of the tool, so that the material removed by the tool while executing the incision, is in fact less than would correspond to a groove equal to the actual thickness of the tool.

As an alternative, it is possible to accomplish the invention with an apparatus of the type illustrated earlier, but making use of a chuck as indicated in Fig. 8.

On such a chuck the tubular element 5 is fitted without any interference (but preferably in the substantial absence of radial clearance), and is moved in abutment against a fixed shoulder 42, similar to the shoulder 24 described earlier.

On the opposite side, the tubular element is axially constrained by a mobile shoulder 43, moved in abutment and held tightly against the tubular element 5 through screw means 44 or similar members.

In such an embodiment, as in the previous case, any extension of the tubular element 5 is substantially inhibited during processing with the tool 33, so as to determine an incision having minimum or zero width.

According to a further alternative, illustrated in a highly diagrammatic form in Fig. 9, it is possible to accomplish a tubular support with an internal incision, while still, on the other hand, maintaining a width of the incision less than the thickness of the tool, so as to reduce to a minimum the weakening of the tubular element due to the incision.

This can be particularly useful in the case where requirements of smoothness of the surface of the tubular element in contact with the sleeve are particularly severe, for example, in uses in the field of high voltages.

To this end the tubular element 5 can be held inside a supporting member 45, under conditions of axial containment, by friction, that is, by insertion with radial interference, or with a locking shoulder 46, indicated in the figure with dotted lines.

The supporting member 45, rotatably supported by a base 47, is rotated by a motor unit 48.

A tool 49, supported by a tool holder 50, makes the incision of the tubular element, with a relative axial movement with respect to the supporting member 45.

While, under such conditions, further processing of the internal surface of the tubular element is not necessary, a subsequent processing of the external surface of the tubular element may be appropriate, after it has been removed from the supporting member 45, for example, by means of a tool similar to the shaving tool 36 described earlier, so as to obtain the required characteristics of surface smoothness.

Claims

1. Tubular supporting element (5) suitable for supporting a sleeve (1) for covering junctions (15), particularly of cables (3) for transmitting electrical energy, one wall surface (6) of said tubular supporting element (5) having at least one incision (7) which does not pass through to the other wall surface and which is directed according to a helical line suitable for defining a strip (9) wound like a helix with adjacent turns interconnected by a thin cord (10) also wound like a helix, characterized in that

(i) said incision (7) has a substantially reverse V-shaped cross-section,

(ii) said incision having a mouth (8) at said wall surface (6) having a width of less than 0.1 mm,

(iii) whereby said one wall surface (6) is substantially smooth and penetration of said sleeve (1) into said incision (7) is substantially prevented when said sleeve (1) is on said tubular supporting element (5).

2. Tubular supporting element (5) according to

- claim 1, characterized in that said incision (7) has a mouth (8) at said one wall surface (6) having a width of less than 0.05 mm.
3. Tubular supporting element (5) according to claim 1, characterized in that said strip (9) has a substantially rectangular cross-section. 5
 4. Tubular supporting element (5) according to claim 1, characterized in that said one wall surface (6) is the external wall surface of said tubular element (5). 10
 5. Tubular supporting element (5) according to claim 1, characterized in that said one wall surface (6) is the internal wall surface of said tubular element (5). 15
 6. A set for covering junctions (15), particularly for cables (3) for transmitting electrical energy, comprising a tubular supporting element (5) as defined in any one of claims 1 to 5 and a covering sleeve (1) of elastomeric material, fitted under conditions of elastic expansion over said tubular supporting element (5). 20
25
 7. Process for making a tubular supporting element (5) suitable for supporting a sleeve (1) for covering junctions (15), particularly of cables (3) for transmitting electrical energy, one wall surface (6) of said tubular supporting element (5) having at least one incision (7) which does not pass through to the other wall surface and which is directed according to a helical line, characterized in that it includes the steps of: 30
35
 - a) constraining the abovementioned tubular element (5) to supporting means (22, 45) under conditions of substantial axial containment and
 - b) making said incision (7) by removing chips (35) of said tubular element material, 40
 for obtaining said incision (7) having
 - (i) a substantially reverse V-shaped cross-section,
 - (ii) said incision having a mouth (8) at said wall surface (6) having a width of less than 0.1 mm, 45
 - (iii) whereby said one wall surface (6) is substantially smooth and penetration of said sleeve (1) into said incision (7) is substantially prevented when said sleeve (1) is on said tubular supporting element (5). 50
 8. Process according to claim 7, characterized in that said incision (7) in said one wall surface (6) is made substantially at room temperature. 55
 9. Process according to claim 7, characterized in that it further includes a step of smoothening of said one wall surface (6), said one wall surface (6) being the external surface of the tubular supporting element (5).
 10. Process according to claim 9, characterized in that said smoothening step of the external wall of said tubular supporting element (5) is simultaneous with the step of executing said incision (7).
 11. Apparatus suitable for making a tubular supporting element (5) suitable for supporting a sleeve (1) for covering junctions (15), particularly of cables (3) for transmitting electrical energy, one wall surface (6) of said tubular supporting element (5) having at least one incision (7) which does not pass through to the other wall surface and which is directed according to a helical line, comprising means (22; 45) for supporting the tubular element (5) and means for cutting (33) suitable for making said incision (7), characterized in that
 - 1) said supporting means (22; 45) support said tubular element (5) under conditions of axial containment and
 - 2) said cutting means (33) make said incision (7) by removing chips (35) of said tubular element material, 55
 for obtaining said incision (7) having
 - (i) a substantially reverse V-shaped cross-section,
 - (ii) said incision having a mouth (8) at said wall surface (6) having a width of less than 0.1 mm,
 - (iii) whereby said one wall surface (6) is substantially smooth and penetration of said sleeve (1) into said incision (7) is substantially prevented when said sleeve (1) is on said tubular supporting element (5).
 12. Apparatus according to claim 11, characterized in that said cutting means (33) is provided with a cutting blade (33) having a thickness that is substantially larger than the width of said incision (7).
 13. Apparatus according to claim 12, characterized in that said cutting blade (33) has a thickness, in the direction of the width of said incision (7), that is not less than 0.5 mm.
 14. Apparatus according to claim 12, characterized in that said cutting blade (33) has a thickness ranging from 0.8 mm to 1 mm.
 15. Apparatus according to claim 11, characterized in that said supporting means (22; 45) are suitable for supporting said tubular element (5) under conditions of radial interference, said interference

being such as to substantially inhibit the axial extension of said tubular element (5), while said incision (7) is being made.

16. Apparatus according to claim 15, characterized in that said radial interference has a value ranging from 0.2% to 0.5% of the internal diameter of said tubular element (5), the tubular element materials having a coefficient of elasticity $E = 800$ to 1000 MPa.
17. Apparatus according to claim 11, characterized in that said supporting means (22; 45) engage with shoulders (42, 43) suitable for accomplishing said axial containment of said tubular element (5).
18. Apparatus according to claim 11, characterized in that it comprises means for smoothening (36) the external wall (6) of said tubular element (5).

Patentansprüche

1. Rohrförmiges Abstützelement (5), das zum Abstützen einer Hülse (1) für eine Abdeckung von Verbindungen (15), insbesondere von Kabeln (3) für den Transport elektrischer Energie, geeignet ist, wobei eine Wandfläche (6) des rohrförmigen Abstützelements (5) wenigstens einen Einschnitt (7) hat, der nicht durch die andere Wandfläche hindurchgeht und der entsprechend einer Schraubenlinie ausgerichtet ist, die zur Bildung eines Bandes (9) geeignet ist, das wie eine Helix gewunden ist, wobei benachbarte Windungen durch eine dünne Schnur (10) miteinander verbunden sind, die ebenfalls wie eine Helix gewunden ist, dadurch gekennzeichnet,
 - (i) daß der Einschnitt (7) einen Querschnitt in Form eines im wesentlichen umgekehrten V hat und
 - (ii) daß der Einschnitt eine Mündung (8) an der Wandfläche (6) mit einer Breite von weniger als $0,1$ mm hat,
 - (iii) wodurch die eine Wandfläche (6) im wesentlichen glatt ist und ein Eindringen der Hülse (1) in den Einschnitt (7) im wesentlichen unterbunden wird, wenn sich die Hülse (1) auf dem rohrförmigen Abstützelement (5) befindet.
2. Rohrförmiges Abstützelement (5) nach Anspruch 1, dadurch gekennzeichnet, daß der Einschnitt (7) eine Mündung (8) an der einen Wandfläche (6) mit einer Breite von weniger als $0,05$ mm hat.
3. Rohrförmiges Abstützelement (5) nach Anspruch 1, dadurch gekennzeichnet, daß das Band (9) einen im wesentlichen rechteckigen Querschnitt

hat.

4. Rohrförmiges Abstützelement (5) nach Anspruch 1, dadurch gekennzeichnet, daß die eine Wandfläche (6) die äußere Wandfläche des rohrförmigen Elements (5) ist.
5. Rohrförmiges Abstützelement (5) nach Anspruch 1, dadurch gekennzeichnet, daß die eine Wandfläche (6) die innere Wandfläche des rohrförmigen Elements (5) ist.
6. Garnitur zum Abdecken von Verbindungen (15), insbesondere für Kabel (3) zum Transport elektrischer Energie, mit einem rohrförmigen Abstützelement (5) nach einem der Ansprüche 1 bis 5 und einer überdeckenden Hülse (1) aus elastomerem Material, die unter Bedingungen einer elastischen Expansion über das rohrförmige Abstützelement (5) aufgepaßt ist.
7. Verfahren zur Herstellung eines rohrförmigen Abstützelements (5), das zum Abstützen einer Hülse (1) für eine Abdeckung von Verbindungen (15), insbesondere von Kabeln (3) zum Transport elektrischer Energie, geeignet ist, wobei eine Wandfläche (6) des rohrförmigen Abstützelements (5) wenigstens einen Einschnitt (7) hat, der nicht durch die andere Wandfläche hindurchgeht und der entsprechend einer Schraubenlinie ausgerichtet ist, dadurch gekennzeichnet, daß das Verfahren die Schritte aufweist
 - a) zwangsweises Anbringen des oben erwähnten rohrförmigen Elements (5) an Trageinrichtungen (22, 45) unter Bedingungen einer wesentlichen axialen Aufnahme und
 - b) Ausführen des Einschnitts (7) durch Entfernen von Spänen (35) des Materials des rohrförmigen Elements zur Erzielung des Einschnitts (7), welcher
 - (i) einen Querschnitt in Form eines im wesentlichen umgekehrten V und
 - (ii) eine Mündung (8) an der Wandfläche (6) mit einer Breite von weniger als $0,1$ mm hat,
 - (iii) wodurch die eine Wandfläche (6) im wesentlichen glatt ist und ein Eindringen der Hülse (1) in den Einschnitt (7) im wesentlichen unterbunden wird, wenn sich die Hülse (1) auf dem rohrförmigen Abstützelement (5) befindet.
8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der Einschnitt (7) in der einen Wandfläche (6) im wesentlichen bei Raumtemperatur durchgeführt wird.
9. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß es weiterhin einen Schritt des Glät-

tens der einen Wandfläche (6) aufweist, wobei die eine Wandfläche (6) die äußere Fläche des rohrförmigen Abstützelements (5) ist.

10. Verfahren nach Anspruch 9, dadurch gekennzeichnet, daß der Glättungsschritt der äußeren Wand des rohrförmigen Abstützelements (5) gleichzeitig mit dem Schritt der Ausführung des Einschnitts (7) erfolgt. 5
11. Vorrichtung zur Herstellung eines rohrförmigen Abstützelements (5), das zum Abstützen einer Hülse (1) für eine Abdeckung von Verbindungen (15), insbesondere von Kabeln (3) für den Transport elektrischer Energie, geeignet ist, wobei eine Wandfläche (6) des rohrförmigen Abstützelements (5) wenigstens einen Einschnitt (7) hat, der nicht durch die andere Wandfläche hindurchgeht und der entsprechend einer Schraubenlinie ausgerichtet ist, mit Trageinrichtungen (22, 45) für das rohrförmige Element (5) und mit Schneideinrichtungen (33) zur Ausführung des Einschnitts (7), dadurch gekennzeichnet, 10
1) daß die Trageinrichtungen (22, 45) das rohrförmige Element (5) unter Bedingungen einer axialen Aufnahme tragen und
2) daß die Schneideinrichtungen (33) den Einschnitt (7) durch Entfernen von Spänen (35) des Materials des rohrförmigen Elements ausführen, 15
um den Einschnitt (7) zu erhalten, der
(i) einen Querschnitt in Form eines im wesentlichen umgekehrten V und
(ii) eine Mündung (8) an der Wandfläche (6) mit einer Breite von weniger als 0,1 mm hat, 20
(iii) wodurch die eine Wandfläche (6) im wesentlichen glatt ist und ein Eindringen der Hülse (1) in den Einschnitt (7) im wesentlichen unterbunden wird, wenn sich die Hülse (1) auf dem rohrförmigen Abstützelement (5) befindet. 25
12. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, daß die Schneideinrichtungen (33) mit einem Schneidblatt (33) versehen sind, das eine Dicke hat, die wesentlich größer als die Breite des Einschnitts (7) ist. 30
13. Vorrichtung nach Anspruch 12, dadurch gekennzeichnet, daß das Schneidblatt (33) in der Richtung der Breite des Einschnitts (7) eine Dicke hat, die nicht weniger als 0,5 mm beträgt. 35
14. Vorrichtung nach Anspruch 12, dadurch gekennzeichnet, daß das Schneidblatt (33) eine Dicke im Bereich von 0,8 mm bis 1 mm hat. 40
15. Vorrichtung nach Anspruch 11, dadurch gekenn- 45

zeichnet, daß die Trageinrichtungen (22, 45) zum Tragen des rohrförmigen Elements (5) unter Bedingungen einer radialen Einwirkung geeignet sind, wobei die Einwirkung derart ist, daß ein axiales Aufweiten des rohrförmigen Elements (5) während der Ausführung des Einschnitts (7) im wesentlichen unterbunden wird.

16. Vorrichtung nach Anspruch 15, dadurch gekennzeichnet, daß die radiale Einwirkung einen Wert im Bereich von 0,2 % bis 0,5 % des Innendurchmessers des rohrförmigen Elements (5) hat, wobei die Materialien des rohrförmigen Elements einen Elastizitätskoeffizienten E von 800 bis 1000 MPa haben. 50
17. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, daß die Trageinrichtungen (22, 45) mit Schultern (42, 43) in Eingriff stehen, die zur Erzielung der axialen Aufnahme des rohrförmigen Elements (5) geeignet sind. 55
18. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, daß sie Einrichtungen (36) zum Glätten der äußeren Wand (6) des rohrförmigen Elements (5) aufweist.

Revendications

1. Élément de support tubulaire (5) approprié pour supporter une gaine (1) destinée à recouvrir des jonctions (15), particulièrement de câbles (3) servant à transmettre l'énergie électrique, une (6) desdites surfaces de paroi (6) dudit élément de support tubulaire (5) comportant au moins une incision (7) qui ne pénètre pas jusqu'à l'autre surface de paroi et qui est dirigée suivant une ligne hélicoïdale appropriée pour définir une bande (9) enroulée en hélice, dont les spires adjacentes sont interconnectées par un mince cordon (10) enroulé également en hélice, caractérisé en ce que :
(i) ladite incision (7) a une section droite sensiblement en forme de V inversé,
(ii) ladite incision présentant, au niveau de ladite surface de paroi, une ouverture (8) ayant une largeur inférieure à 0,1 mm,
(iii) grâce à quoi ladite surface de paroi (6) mentionnée en premier est sensiblement uniforme et la pénétration de ladite gaine (1) dans ladite incision (7) est substantiellement empêchée quand ladite gaine (1) se trouve sur ledit élément de support tubulaire (5). 5
2. Élément de support tubulaire (5) selon la revendication 1, caractérisé en ce que ladite incision (7) présente, au niveau de ladite surface de paroi 8

- (6) mentionnée en premier, une ouverture (8) ayant une largeur inférieure à 0,05 mm.
3. Elément de support tubulaire (5) selon la revendication 1, caractérisé en ce que ladite bande (9) a une section droite sensiblement rectangulaire. 5
 4. Elément de support tubulaire (5) selon la revendication 1, caractérisé en ce que ladite surface de paroi (6) mentionnée en premier est la surface de paroi extérieure dudit élément tubulaire (5). 10
 5. Elément de support tubulaire (5) selon la revendication 1, caractérisé en ce que ladite surface de paroi (6) mentionnée en premier est la surface de paroi intérieure dudit élément tubulaire (5). 15
 6. Ensemble pour recouvrir des jonctions (15), particulièrement pour des câbles (3) servant à transmettre de l'énergie électrique, comprenant un élément de support tubulaire (5) selon l'une quelconque des revendications 1 à 5, et une gaine de recouvrement (1) en matière élastomère, emmanchée dans un état d'expansion élastique sur ledit élément de support tubulaire (5). 20
 7. Procédé pour fabriquer un élément de support tubulaire (5) approprié pour supporter une gaine (1) destinée à recouvrir des jonctions, particulièrement de câbles (3) servant à transmettre de l'énergie électrique, une (6) des surfaces de paroi dudit élément de support tubulaire (5) comportant au moins une incision (7) qui ne pénètre pas jusqu'à l'autre surface de paroi et qui est dirigée selon une ligne hélicoïdale, caractérisé en ce qu'il comprend les étapes consistant : 25
 - a) à retenir de force ledit élément tubulaire (5) sur un moyen de support (22, 45) dans un état de retenue axiale, et
 - b) à effectuer ladite incision (7) en enlevant des copeaux (35) de la matière dudit élément tubulaire afin d'obtenir ladite incision (7) ayant
 - (i) une section droite sensiblement en forme de V inversé, 30
 - (ii) ladite incision présentant, au niveau de ladite surface de paroi (6), une ouverture (8) ayant une largeur inférieure à 0,1 mm, 35
 - (iii) grâce à quoi ladite surface de paroi (6) mentionnée en premier est sensiblement uniforme et la pénétration de ladite gaine (1) dans ladite incision (7) est substantiellement empêchée quand ladite gaine (1) se trouve sur ledit élément de support tubulaire (5). 40
 8. Procédé selon la revendication 7, caractérisé en ce que ladite incision (7) dans ladite surface de paroi (6) mentionnée en premier est effectuée 45

sensiblement à la température ambiante.

9. Procédé selon la revendication 7, caractérisé en ce qu'elle comprend, en outre, une étape d'uniformisation de ladite surface de paroi (6) mentionnée en premier, ladite surface de paroi (6) mentionnée en premier étant la surface extérieure de l'élément de support tubulaire (5).
10. Procédé selon la revendication 9, caractérisé en ce que ladite étape d'uniformisation de la paroi extérieure dudit élément de support tubulaire (5) a lieu simultanément avec l'étape d'exécution de ladite incision (7).
11. Appareil approprié pour fabriquer un élément de support tubulaire (5) approprié pour supporter une gaine (1) destinée à recouvrir des jonctions (15), particulièrement de câbles (3) servant à transmettre de l'énergie électrique, une (6) des surfaces de paroi dudit élément de support tubulaire (5) comportant au moins une incision (7) qui ne pénètre pas jusqu'à l'autre surface de paroi et qui est dirigée selon une ligne hélicoïdale, comprenant un moyen (22; 45) pour supporter l'élément tubulaire (5) et un moyen de coupe (33) approprié pour effectuer ladite incision (7), caractérisé en ce que
 - 1) ledit moyen de support (22; 45) supporte ledit élément tubulaire (5) dans un état de retenue axiale, et
 - 2) ledit moyen de coupe (33) effectue ladite incision (7) en enlevant des copeaux (35) de la matière dudit élément tubulaire pour obtenir ladite incision (7) ayant
 - (i) une section droite sensiblement en forme de V inversé,
 - (ii) ladite incision présentant, au niveau de ladite surface de paroi (6), une ouverture (8) ayant une largeur inférieure à 0,1 mm,
 - (iii) grâce à quoi ladite surface de paroi (6) mentionnée en premier est sensiblement uniforme et la pénétration de ladite gaine (1) dans ladite incision (7) est pratiquement empêchée quand ladite gaine (1) se trouve sur ledit élément de support tubulaire (5).
12. Appareil selon la revendication 11, caractérisé en ce que ledit moyen de coupe (33) est pourvu d'une lame de coupe (33) ayant une épaisseur qui est notablement plus grande que la largeur de ladite incision (7).
13. Appareil selon la revendication 12, caractérisé en ce que ladite lame de coupe (33) a, dans la direction de la largeur de ladite incision (7), une épaisseur qui est inférieure à 0,5 mm.

14. Appareil selon la revendication 12, caractérisé en ce que ladite lame de coupe (33) a une épaisseur comprise entre 0,8 mm et 1 mm.
15. Appareil selon la revendication 11, caractérisé en ce que ledit moyen de support (22; 45) est approprié pour supporter ledit élément tubulaire (5) dans des conditions d'interférence radiale, ladite interférence radiale étant telle qu'elle neutralise substantiellement l'allongement dudit élément tubulaire (5) pendant que ladite incision (7) est effectuée. 5 10
16. Appareil selon la revendication 15, caractérisé en ce que ladite interférence correspond à une valeur comprise entre 0,2% et 0,5% du diamètre intérieur dudit élément tubulaire (5), les matières constituant l'élément tubulaire ayant un coefficient d'élasticité E de 800 à 1000 MPa. 15 20
17. Appareil selon la revendication 11, caractérisé en ce que ledit moyen de support (22; 45) porte contre des épaulements (42, 43) appropriés pour assurer ladite retenue axiale dudit élément tubulaire (5). 25
18. Appareil selon la revendication 11, caractérisé en ce qu'il comprend un moyen (36) pour uniformiser la paroi extérieure (6) dudit élément tubulaire (5). 30 35 40 45 50 55 10

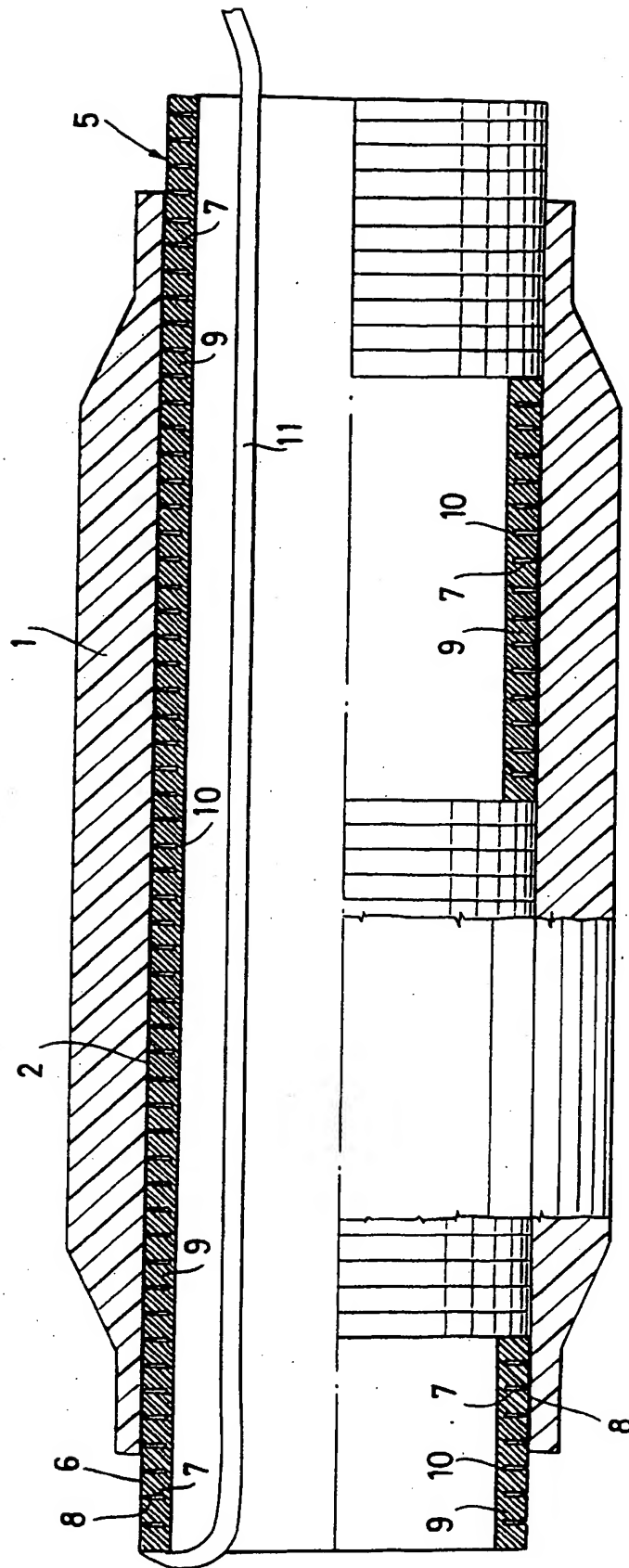


Fig.1

This Page Blank (upside down)

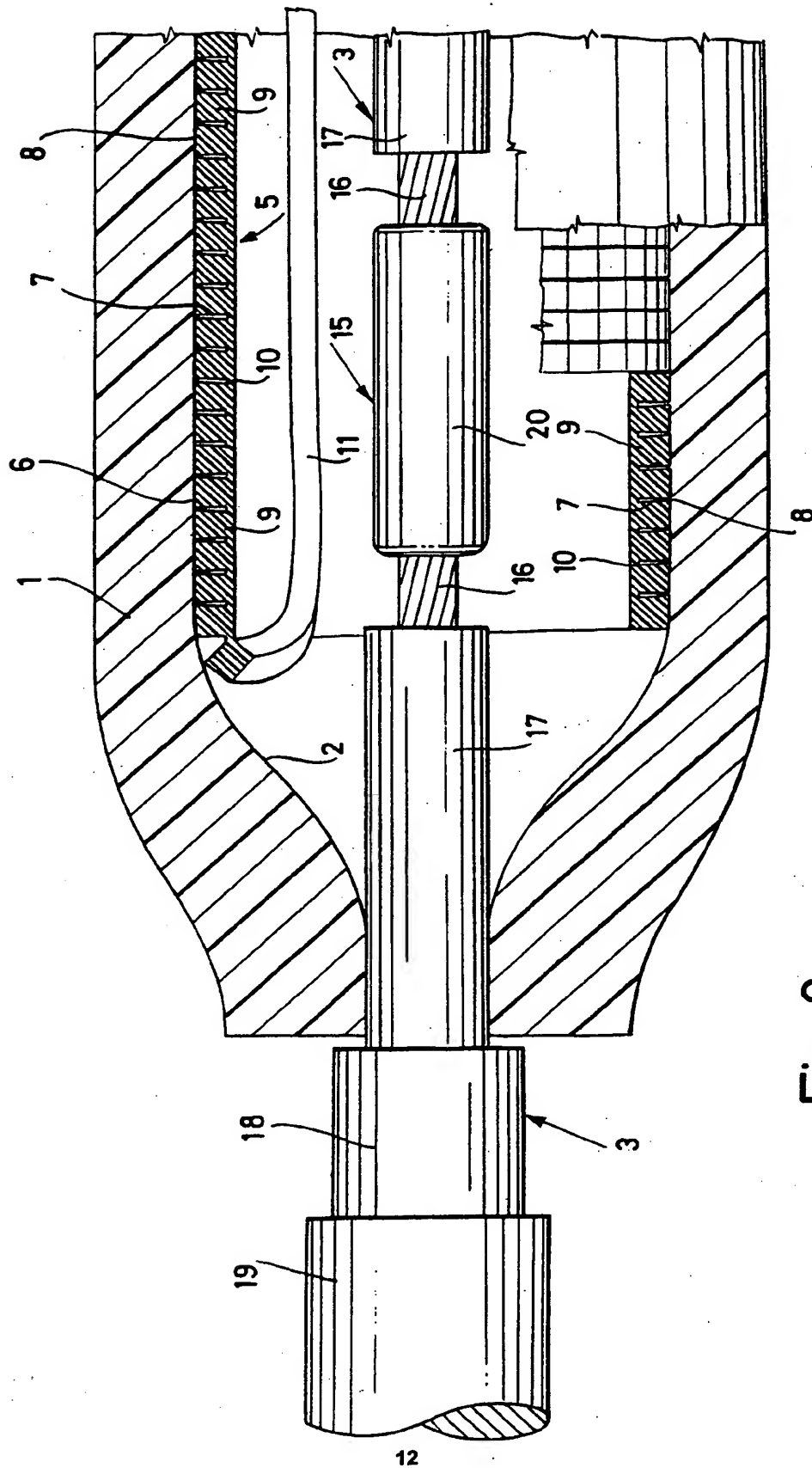


Fig. 2

This Page Blank (uspiu,

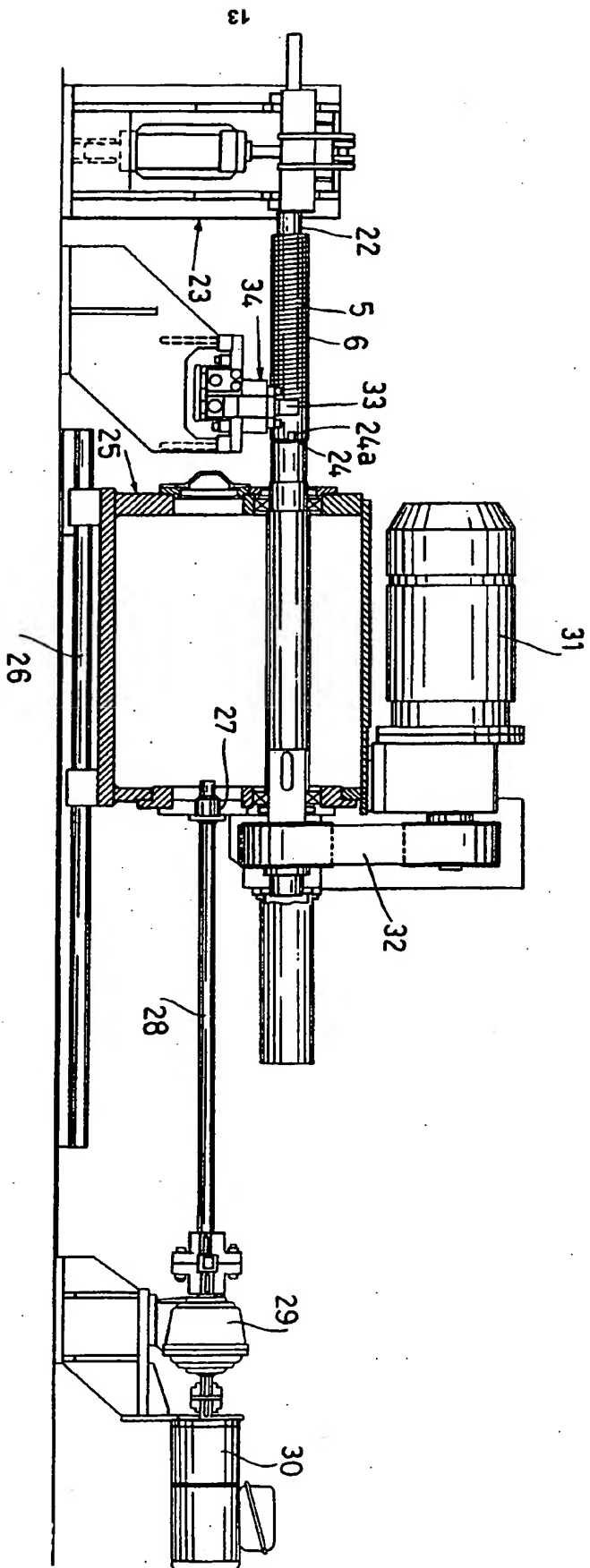


Fig. 3

This Page Blank (uspic,

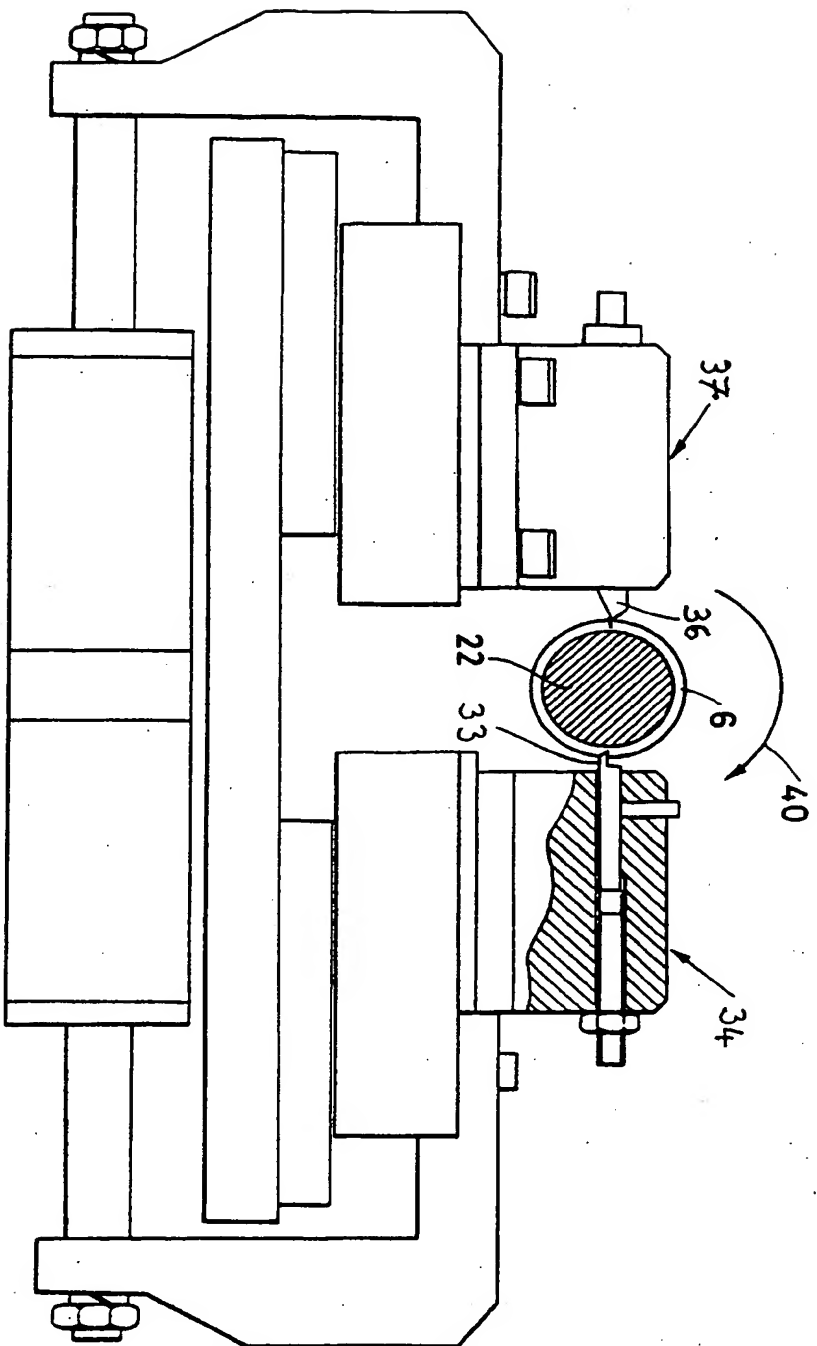


Fig. 4

14

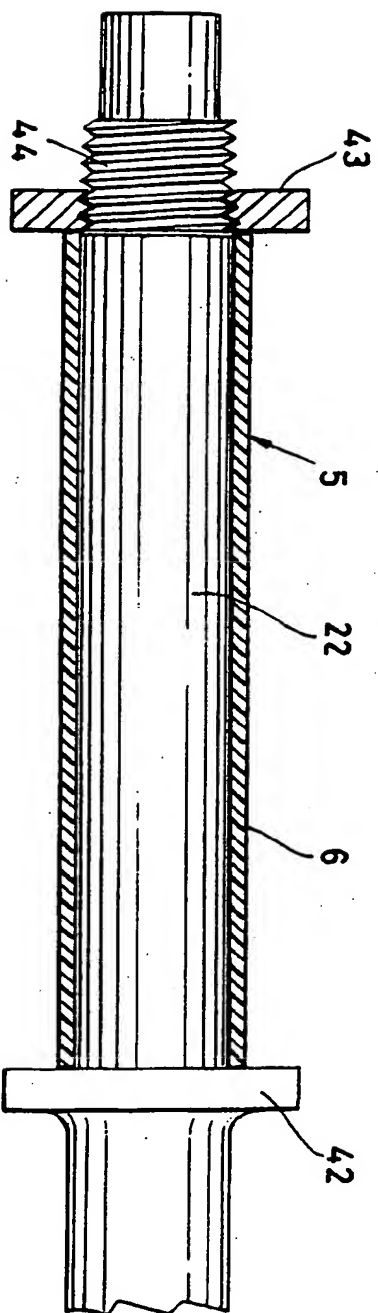


Fig. 8

...is Page Blank (uspro)

Fig. 6

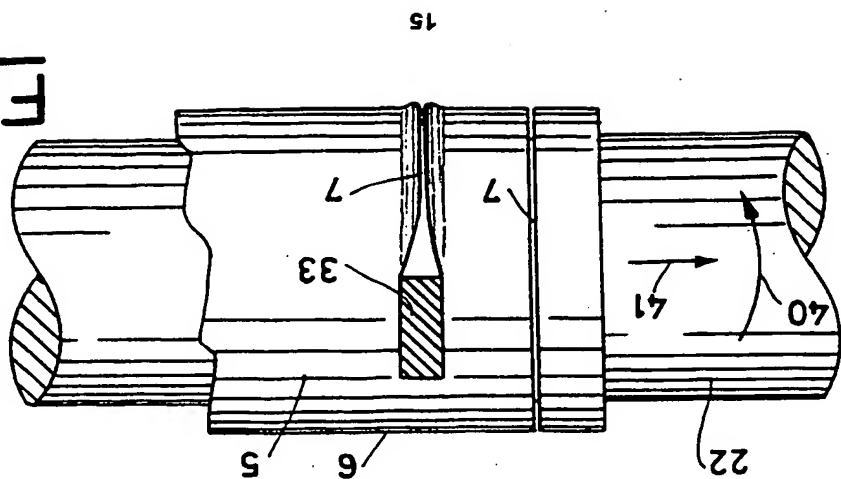


Fig. 7

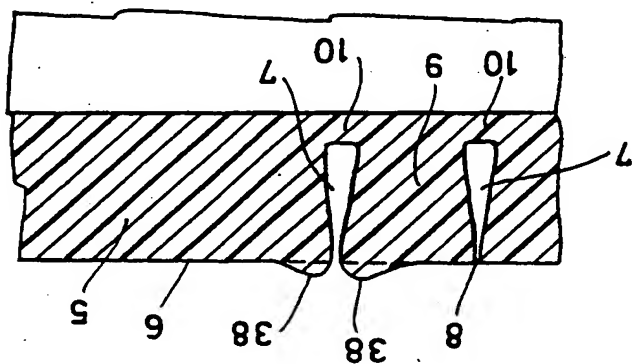
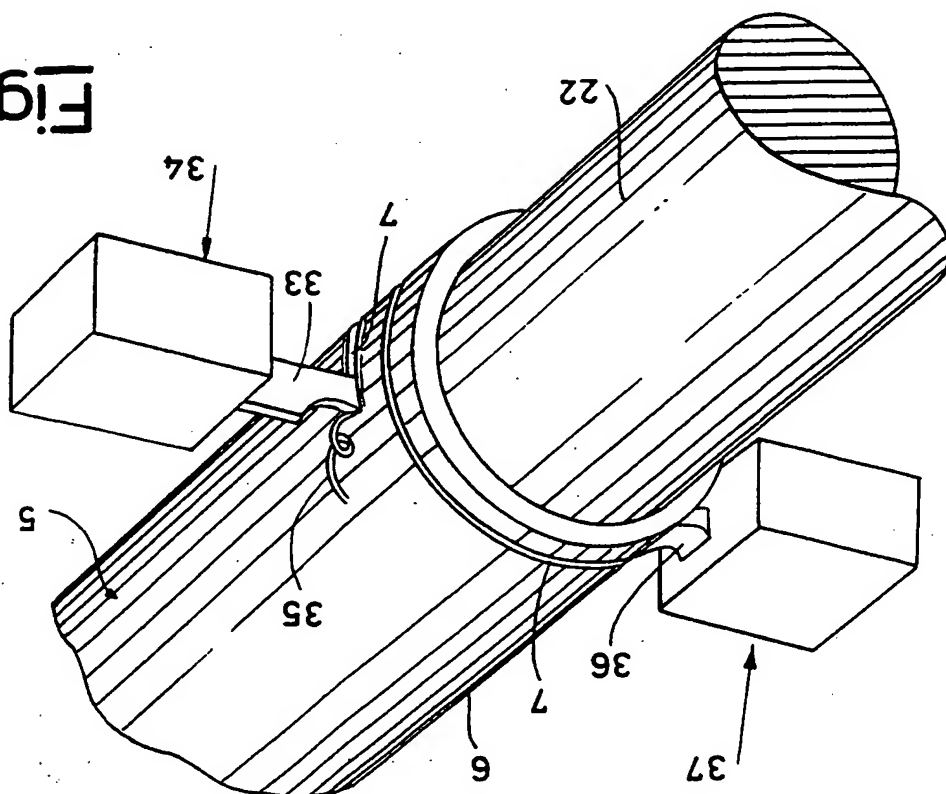


Fig. 5



This Page Blank (uspio)

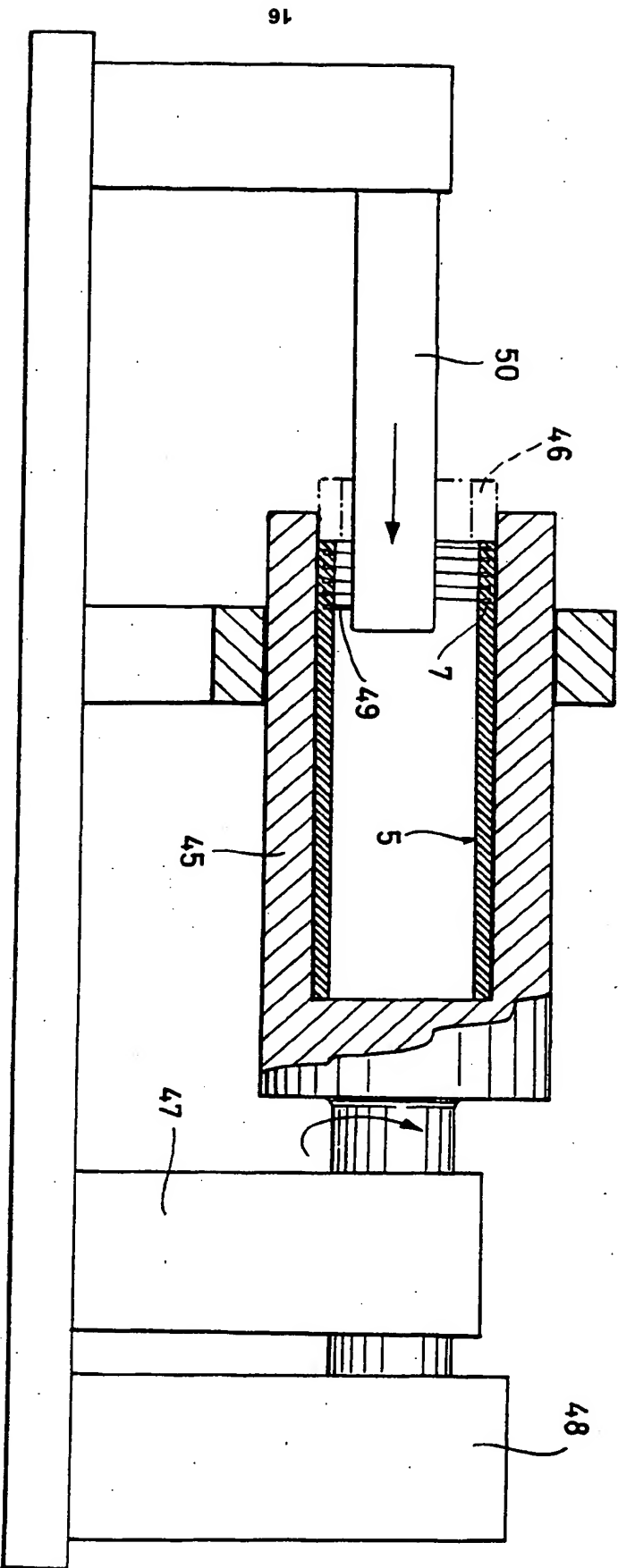


Fig. 9

This Page Blank (uspi0,

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☒ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☒ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☒ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.

This Page Blank (uspto)